SECTION 16130

RACEWAY AND BOXES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metal conduit.
2. Flexible metal conduit.
3. Liquidtight metal conduit.
4. Electrical metallic tubing.
5. Nonmetal conduit.
6. Fittings and conduit bodies.
7. Wall and ceiling outlet boxes.
8. Pull and junction boxes.
9. Cable trays.
10. Floor boxes with covers for EAS system.

B. Related Documents: The Contract Documents apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

C. Related Sections:

1. Section 16120 - Conductors and Cables: Conductors installed in conduit.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM A 123 - Specification for Zinc (Hot-Galvanizes) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.

B. American National Standards Institute (ANSI):

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
3. ANSI C80.5 - Rigid Aluminum Conduit.

C. National Electrical Contractors Association (NECA):
1. NECA "Standard of Installation."

D. National Electrical Manufacturers Association (NEMA):

1. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
2. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
3. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
4. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
5. NEMA VE 1 - Metallic Cable Tray Systems.

E. National Fire Protection Association (NFPA):
1. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

A. Design Requirements
1. Conduit Size: NFPA 70, unless indicated otherwise on Drawings.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Conform to requirements of NFPA 70.
   2. Provide products listed and classified by Underwriters Laboratories, Incorporated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Product Requirements: Transport, handle, store, and protect products.

B. Accept conduit on site. Contractor inspect for damage prior to acceptance.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.1 CONDUIT REQUIREMENTS

A. Install wiring in conduit, including low voltage, control, and communications.

B. Minimum size conduit as follows:
   1. 3/4 inch for power and branch circuit wiring, unless indicated otherwise.
   2. 3/4 inch for telephone, unless indicated otherwise.
   3. 1/2 inch for low voltage, control, fire alarm, intercom, security and communications (other than telephone) unless indicated otherwise.

C. Install in accordance with the following schedule, unless indicated otherwise on Drawings: No plastic flexible PVC conduit permitted. Intermediate grade rigid conduit permitted where indicated below.
   1. Above Suspended Ceilings: Galvanized or sheradized thick wall rigid steel (GRC), or intermediate grade rigid steel (IMC), or electrical metallic tubing (EMT).
   2. Metal Stud Walls: Galvanized or sheradized thick wall rigid steel (GRC), intermediate grade rigid steel (IMC), or electrical metallic tubing (EMT).
   3. Exposed Interior Areas: Galvanized or sheradized thick wall rigid steel (GRC), intermediate grade rigid steel (IMC), electrical metallic tubing (EMT).

2.2 METAL CONDUIT

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. Allied.
   2. Wheatland.
   3. Republic.
   4. Substitutions: Permitted with Owner’s approval

B. Rigid Galvanized Steel Conduit (GRC): ANSI C80.1, UL6.

C. Intermediate Metal Conduit (IMC): UL1242.

D. Fittings and Conduit Bodies: NEMA FB1 Material to match conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. Hubbell.
   2. Electroflex.
   3. 0-Z/Gedney.
   4. Substitutions: Permitted with Owner's approval

B. Description: Interlocked steel and aluminum construction.

C. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:

   1. Hubbell.
   2. Electroflex.
   3. Seal-Tite.
   4. Substitutions: Permitted with Owner's approval

B. Description: Interlocked steel and aluminum construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:

   1. Allied.
   2. Wheatland.
   3. Republic.
   4. Substitutions: Permitted with Owner's approval.

B. Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron compression type. Die-cut Zinc not permitted.

2.6 NONMETALLIC CONDUIT

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. Carlon.
   2. Substitutions: Permitted with Owner's approval.

B. Description: NEMA TC 2; Schedule 40 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.7 FITTINGS

A. Manufacturer: Raco.

1. Subject to compliance with project requirements, one of the following manufacturers may also be provided:
   a. Steel City.
   b. 0-Z/Gedney.
2. Substitutions: Permitted with Owner's approval.

B. Conduits 1/2 inch thru 1 inch enter junction boxes, pull boxes, panels, cabinets, and gutters, provide the following:
1. Rigid Conduit: Insulated throat connectors; Raco 3802, 3803, 3804, 3602.
2. Flexible Metal Conduit: Raco 3302, 3303, 3304, 3305, 3306, 3308.
3. Liquidtiight Flexible Metal Conduit: Raco 3511, 3512, 3513, 3541, 3542, 3543.

C. Conduits 1-1/4 inch and larger entering junction boxes, pull boxes, panels, cabinets, and gutters, provide Insulated throat grounding bushings; Raco 1225, 1226, 1228, 1230, 1232, 1234, 1236.

D. Provide threaded joint connectors and malleable iron no thread compression box connectors on rigid conduit. Do not provide fittings requiring set screws or indentor type applications including BM connectors.

E. Provide only steel or malleable iron compression couplings and connectors on EMT conduit.

2.8 CONDUIT STRAPS AND HANGERS

A. Strap Manufacturer: Raco.
1. Subject to compliance with project requirements, one of the following manufacturers may also be provided:
   a. Steel City.
   b. Unistrut.
2. Substitutions: Permitted with Owner's approval.

B. Hanger Manufacturer: Steel City.
1. Subject to compliance with project requirements, one of the following manufacturers may also be provided:
   a. Unistrut.
   b. Raco.
2. Substitutions: Permitted with Owner's approval itted.

C. Straps: Two hole push on stamped steel straps on surface areas such as concrete, masonry, wide flange beams, columns, and wood.
1. Rigid Conduit: Raco 2232, 2233, 2234, 2235, 2336, 2238.
2. Electrical Metallic Tubing: Raco 2092, 2093, 2094.

D. Hangers: Lay-in pipe hanger.
1. Conduits 1-1/4 Inch and Larger: Steel-City C-149.

E. Trapeze Hangers for Conduits Grouped Together: Hangers consisting of all thread rods sized as required and Kingdorff channel.
1. Steel City B-909, 1/2 inch x 1-7/8 inch (12 gauge) with single bolt channel pipe straps.
2. Steel City C-105, C-105-AL, or C-106, (no wire permitted for anchoring conduit).

2.9 SEAL-OFF AND EXPANSION FITTINGS

A. Seal-Off Fitting Manufacturer: Crouse-Hinds.
1. Subject to compliance with project requirements, one of the following manufacturers may also be provided:
   a. Killark.

b. Appleton.
2. Substitutions: Permitted with Owner’s approval.

B. Expansion Fitting Manufacturer: OZ Gedney.
1. Subject to compliance with project requirements, one of the following manufacturers may also be provided:
a. Crouse-Hinds.
b. Killark.
c. Appleton.
2. Substitutions: Permitted with Owner’s approval.

C. Provide seal-off fittings where required by governing authority, code, or as indicated on Drawings.
1. Vertical Runs: Crouse-Hinds Type EYS.
2. Horizontal and Vertical Runs: Crouse-Hinds Type EZS.
3. Elbows: Crouse-Hinds Type EYS.
4. Sealing Compound: "Chico X" fiber and "Chico A".

D. Provide expansion fittings in conduits where indicated on Drawings or where required to pass through expansion joints embedded in concrete.
1. OZ Gedney Type AX.

2.10 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
2. Receptacle and Switch Boxes - 4 inch square x 2-1/8 inch deep with raised gang plaster ring unless indicated otherwise.

B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

C. Wall Plates for Finished Areas: Specified in Section 16140.

2.11 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

2.12 LADDER-TYPE CABLE TRAY

A. Description: NEMA VE 1, Class 20C ladder type tray.

B. Material: Steel.

C. Finish: ASTM A 123, hot dipped galvanized after fabrication.

D. Inside Width and Depth: Indicated on Drawings.

E. Straight Section Rung Spacing: 9 inches on center.

F. Inside Radius of Fittings: 24 inches.

G. Provide approved manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

H. Engraved Nameplates: 1/2 inch high black letters on yellow laminated plastic nameplate, engraved with the following wording:

WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution Requirements: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
   1. Verify routing and termination locations of conduit prior to rough-in.

C. Report in writing to prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the .

3.2 INSTALLATION - RACEWAYS

A. Install conduit in accordance with NECA "Standard of Installation."

B. Install nonmetallic conduit in accordance with manufacturer's instructions. Nonmetallic conduit shall only be used under slabs or direct buried in earth. Conduit penetrations through slab including elbows shall be galvanized rigid conduit.

C. Conduit routing indicated on Drawings are approximate locations unless dimensioned. Route parallel and perpendicular to building construction for complete wiring system regardless whether exposed or concealed.

D. Arrange supports to prevent misalignment during wiring installation.

E. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

F. Group related conduits; support using conduit rack. Construct rack using approved steel channel, provide space on each for 25 percent additional conduits.

G. Fasten conduit supports to building structure and surfaces under provisions of this section.

H. Do not support conduit with wire or perforated pipe straps in any type structure. Remove wire used for temporary supports. Steel tie wire may be used to anchor conduit down to reinforcing rods in concrete encasement only.

I. Do not attach conduit to ceiling support wires.

J. Arrange conduit to maintain headroom and present neat appearance.

K. Route all conduit whether exposed or concealed parallel and perpendicular to walls, ceilings, building structures, etc.

L. Maintain required clearance between conduit and piping.

M. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

N. Cut EMT conduit square using saw or pipecutter; de-burr cut ends and ream.

O. Bring conduit to shoulder of fittings; fasten securely.

P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

Q. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. Use myers hub connectors on all conduit entering top or sides of all junction boxes, pull boxes, wiring gutters, exposed to weather.

R. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate or use factory elbows for bends in metal conduit larger than 2 inch size. Telephone and computer system conduit bends shall not exceed three 90 degree turns prior to installing pull box. Comply with Article 346 of NFPA 70 on all bends.

S. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

T. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.

U. Provide suitable nylon pull string or #14 AWG steel wire in each conduit except sleeves and nipples.

V. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

W. Ground and bond conduit per NFPA 70.

X. Coat all metallic conduit male threads with "General Electric" RTV silicone sealer where conduit is installed in exterior areas or in contact with concrete or earth.

Y. Install all above grade feeders in galvanized or sheradized thick wall rigid steel (GRC), Intermediate metal Conduit (IMC), or Rigid Aluminum (RA).

Z. Conduit larger than 1-1/4 inch trade size, feeder or branch circuit; use galvanized or sheradized thick wall rigid steel (GRC), Intermediate Metal Conduit (IMC), or rigid aluminum (RA).

AA. Conduits sized as indicated on Drawings. Where size not indicted, size per NFPA 70.

BB. Cap all upturned conduits during construction rough-in to prevent moisture or debris from entering. Pull through each and every conduit a dry swab of sufficient size to remove any and all moisture.

CC. Maximum 5 foot length flexible metal conduit (Greenfield), or flexible liquidtite permitted.

DD. Assure ground continuity on all branch circuitry conduits with two locknuts, one inside and one outside of all boxes, cabinets and gutters for rigid conduit. One locknut inside of all boxes, cabinets, and gutters for EMT.

EE. Support Conduits as Follows:

1. Galvanized rigid thick wall conduit (GRC), within three feet of all outlet boxes, junction boxes, cabinets, gutters, or fittings. Horizontally anchored at 10 foot maximum intervals. Other spacings indicated on Drawings.
2. Intermediate grade rigid conduit (IMC), within three feet of all outlet boxes, junction boxes, cabinets, gutters, or fittings. Horizontally anchored at 10 foot maximum intervals.
3. Flexible metal conduit (Greenfield), within 12 inches of all outlet boxes, junction boxes, cabinets, gutters, or fittings and bends or turns. Horizontally anchored at 4-1/2 foot intervals. 3/4 inch minimum size permitted.
4. Liquid-tite flexible conduit (Sealtite), within 12 inches of all outlet boxes, junction boxes, cabinets, gutters, or fittings and bends or turns. Horizontally anchored at 4-1/2 foot intervals. 3/4 minimum size permitted.

3.3 INSTALLATION - BOXES

A. Install boxes in accordance with NECA "Standard of Installation."

B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

C. Set wall mounted boxes at elevations to accommodate mounting heights indicated or as required for specific project requirements.

D. Electrical boxes are indicated on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose with no additional cost to contract.

E. Orient boxes to accommodate wiring devices oriented as specified in Section 16140.

F. Maintain headroom and present neat mechanical appearance.

G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Install pull boxes in freezer and dock area above bottom chord of structural joist.

H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

I. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

J. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.

K. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

L. Use flush mounting 4 inch square outlet box with raised gang cover in finished areas.

M. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening. Use approved raised gang covers in masonry and stud walls.

N. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.

O. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

P. Use approved stamped steel bridges to fasten flush mounting outlet box between studs.

Q. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

R. Use approved adjustable steel channel fasteners spanning joist for hung ceiling outlet box.

S. Do not fasten boxes to ceiling support wires.

T. Support boxes independently of conduit.

U. Use approved gang box where more than one device is mounted together. Do not use sectional box.

V. Use 4 inch square x 2-1/8 inch deep, single gang box with plaster ring for single device outlets.

W. Use cast outlet box with weatherproof cover in exterior locations exposed to the weather.

X. Large Pull Boxes: Use hinged and hasp enclosure in interior dry locations, surface-mounted galvanized steel.

3.4 INSTALLATION - CABLE TRAYS

A. Install in accordance with manufacturer's published instructions.

B. Install metallic cable tray in accordance with NEMA VE 1.

C. Support trays in accordance with Section 16050. Provide supports at each connection point and at the end of each run.

D. Use expansion connectors where required.

E. Ground and bond cable tray under provisions of Section 16050.
1. Provide continuity between tray components.
2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
3. Provide #2 AWG bare copper equipment grounding conductor through entire length of tray; bond to each section.
4. Connections to tray may be made using mechanical connectors.

F. Install warning signs at 50 feet on center along cable tray, located to be visible.

3.5 FIELD QUALITY CONTROL

A. Section 01450 - Quality Control: Field inspection.

B. Inspect conduit installation, types, sizes, fittings and attachment to structure.

C. Inspect box installation, locations, connection to conduit, and attachment to structure.

D. Inspect cable tray installation, locations, connection to conduit, and attachment to structure.

3.6 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

3.7 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish like new.

SECTION 16130

RACEWAY AND BOXES

END OF SECTION